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QUARTERLY PROGRESS REPORT NUMBER 5, 1 JANUARY - 31 MARCH 1971, --ETC(U)
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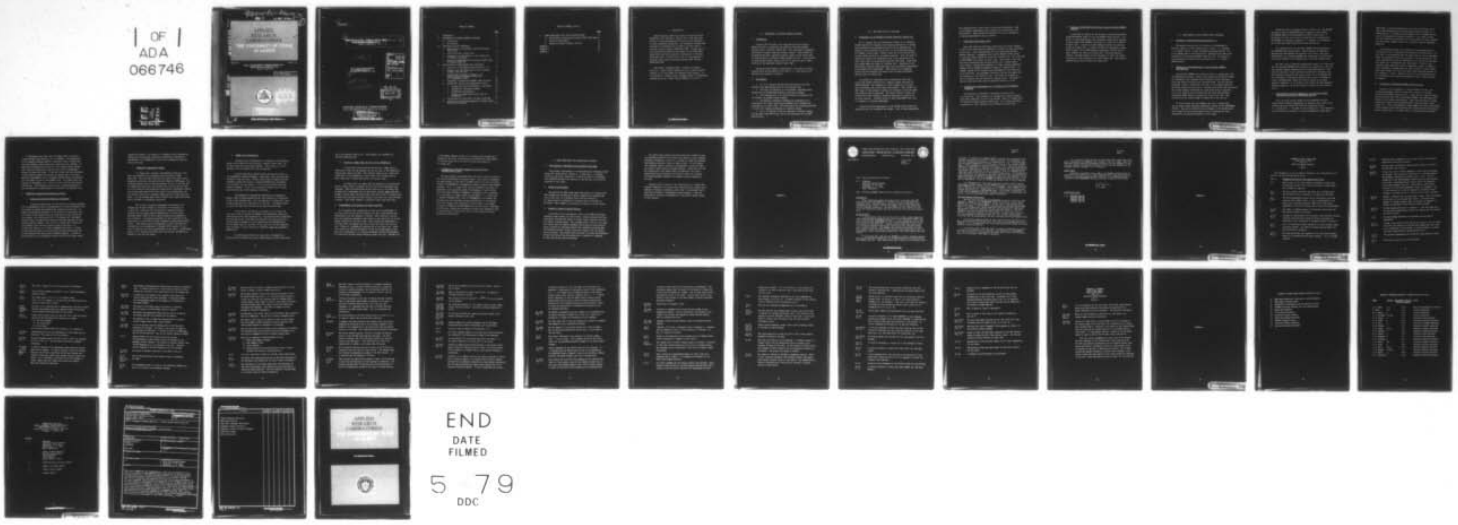

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28 May 1971

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PART I OF QUARTERLY PROGRESS REPORT NO. 5
UNDER CONTRACT N00024-70-C-1117
1 January - 31 March 1971

NAVAL SHIP SYSTEMS COMMAND
Contract N00024-70-C-1117
Proj. Ser. No. SF 1990301, Task 1467

(11) 28 May 1971

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I. INTRODUCTION

Applied Research Laboratories (ARL) was awarded Contract N00024-70-C-1117, effective 1 January 1970. Work under this contract is concerned primarily with the test and evaluation of sonar transducers and systems. The transducer oriented work represents a continuation of a portion of the work under a previous contract, Contract N00024-69-C-1066. Another area of work concerned monitoring the development of the AUTEC Sonar Range (ASR); this work represents a continuation of Contract N00140-69-C-0278. A third area of work is a continuation of submarine sonar research previously pursued under Contract N00024-68-C-1082.

This report, designated PART I of Quarterly Progress Report No. 5 under Contract N00024-70-C-1117, presents current progress on all work *except* the submarine sonar research. It is reported in a separate report, designated PART II of Quarterly Progress Report No. 5 under Contract N00024-70-C-1117 (U).

II. SUBCONTRACT TO STANFORD RESEARCH INSTITUTE

A. Introduction

To assist ARL with many of the tasks assigned under Contract N00024-70-C-1117, a subcontract was awarded to Stanford Research Institute (SRI), effective 1 March 1970. This subcontract, designated ARL-70-SC-01, requires quarterly progress reports. These reports are distributed with ARL's quarterly progress reports and are relied upon to report progress on projects handled primarily by SRI. Joint projects in which ARL has played a direct role will be reported upon in other sections of this quarterly progress report (QPR).

During the fourth quarter of ARL-70-SC-01, SRI worked on several projects which are described in SRI's QPR No. 4. These projects are described very briefly in Section B.

B. SRI Projects

1. Mr. E. M. Spurlock attended and participated in the 10th Meeting of the STEP Working Group on 23-25 February 1971.

2. SRI began an evaluation of a replacement transformer newly designed for the AN/SQS-26BX transducer restoration program.

3. SRI continued work on an improved design of transducers for the AN/UQN-1 and AN/UQN-4 depth sounders.

4. SRI gathered information regarding the preparation of a standardized test report, which would accompany each transducer and hydrophone as it leaves a TRF. This would enable the installing activity to receive the required information in a familiar format.

5. Mr. E. M. Spurlock of SRI has continued to maintain liaison with the Mare Island TRF in his role as the coordinator for the STEP Working Group.

III. STEP BARGE FACILITY OPERATIONS

A. Measurements on the AN/SQS-23 TR-208A Transducer (Serial B-8)

As of 1 January 1971, the measurements lacking on the AN/SQS-23 TR-208A (Serial B-8) transducer were baseline measurements of element source level and receiving sensitivity and receive beam patterns. In December, ARL had received the two units of the AN/SQS-23D necessary for forming a receive beam. However, these units were removed from a stricken vessel and were not in working condition. Thus, the month of January was required for considerable work in the laboratory to get these units ready for installation aboard the STEP barge. These items were loaded aboard the barge on 4 February 1971. Completion of the installation required several more days, with beam pattern measurements being delayed until mid-February. These patterns were completed quickly and the transducer was removed from the barge and shipped away from ARL on 10 March 1971.

The purpose for conducting receive beam pattern tests was to verify beam patterns predicted by a computer program developed for NAVSHIPS PMS-386. The intended use of this program was to predict sonar performance with certain known dead elements. Thus, aboard the STEP barge, certain groups of elements were disabled so that the proper beam patterns could be generated. The overall results of these comparisons were quite favorable; predicted beam patterns proved to be of useful accuracy. Detailed results of these measurements will soon be included in a technical memorandum.

Extensive baseline measurements on the TR-208A (Serial B-8) were completed before the transducer was shipped. Some of these measurements

were completed prior to the receive beam pattern measurements. Some of the baseline measurements were rechecked after completion of the beam patterns. These baseline measurements will also be included in a technical memorandum as soon as possible.

B. C-Tech Electronic Scanner Tests

Since ARL tested the electronic scanner built by C-Tech, Limited, in 1970, it has been desired by NAVSHIPS to recheck the noise performance of this unit. C-Tech reported that the noise improvement had been markedly improved. Arrangements were made by NAVSHIPS 00V31 for ARL to test this scanner during the period 25-29 January 1971. Mr. Scott Gray of NAVSECNORDIV was present for these tests. The results of the tests have been incorporated with previous results into a single report, "Final Report: Side-By-Side Comparison of C-Tech, Limited, Electronic Scanner with the AN/SQS-31 Mechanical Scanners," (ARL-TR-71-15). In summary, results of the testing proved performance of the C-Tech unit to be quite good. Its performance previously had been very good, with the exception of its electronic noise. The recent tests proved it some 5 dB quieter than the mechanical scanning switch. Previously it had been found more noisy than the mechanical switch by 1.5 dB.

C. Preparation for Measurements on the AN/SQS-31/32 TR-238(XN-1) Transducer

ARL received the TR-238(XN-1) transducer (Serial A-1) on 22 January 1971. This transducer was scheduled for baseline measurements after completion of work on the TR-208A. Thus, on 11 March 1971, the TR-238 was loaded aboard the STEP barge. Due to other priorities, measurements on this transducer had not begun by 31 March 1971.

D. Testing of AN/SQS-26BX TR-203 Elements Removed from USS TRUXTON (DLGN 35)

As described in Chapter IV, ARL personnel conducted measurements aboard USS TRUXTON (DLGN 35) with the AN/WQM-5 Sonar Test Set. As a result of these measurements, some transducer elements were replaced. Of those removed from TRUXTON, two groups of 12 were sent to ARL for baseline tests. A group of a dozen rejected elements was received at ARL on 19 March 1971. A bracket suitable for suspending a single TR-203 element off the STEP barge was constructed, and the first of these elements was tested on 31 March 1971. The second group of elements, although measured to have impedance too high, were judged acceptable by tests conducted at the Pearl Harbor TRF. This group of elements had not been received by 31 March 1971.

IV. PARTICIPATION IN STEP WORKING GROUP ACTIVITIES

A. Attendance at STEP Working Group Meeting No. 10

STEP Working Group met at the facilities of NAVSECNORDIV at Norfolk, Virginia, on 23-25 February 1971. Messrs. J. J. Truchard, J. E. Stockton, and D. D. Baker attended the meeting from ARL. One of the agenda items of this meeting was a demonstration by ARL of the operation of the prototype AN/WQM-5 Sonar Test Set. The minutes of this meeting will be written and distributed by Mr. H. C. Evans, NAVSHIPS 00V35.

B. Testing, Use, and Demonstration of the Prototype AN/WQM-5 Sonar Test Set

The prototype AN/WQM-5 was received at ARL on 4 January 1971, with no documentation included. However, ARL personnel were familiar enough with operation of the equipment after witnessing factory acceptance tests that further testing in the laboratory began. The unit was very thoroughly tested in essentially every mode of its proposed operation during the ensuing two week period. No major difficulties were discovered; the voltage sampling transformer was found during factory acceptance tests to be slightly out of specification and Ocean Data Equipment Corporation (ODEC) agreed to replace this item at that time. This difficulty was not severe enough to prevent use of the test set.

On 18-19 January 1971, the AN/WQM-5 was used to conduct ARL's regular single element impedance measurements aboard the USS VOGELGESANG (DD 862). This was the third time that impedance of the TR-208A transducer aboard this ship was monitored since its installation; these measurements are described elsewhere in this report.

During the period 29 January through 3 February 1971, the AN/WQM-5 was used to test two AN/SQS-26BX TR-203 transducer arrays aboard USS TRUXTON (DLGN 35) and USS SAMPLE (DE 1048), respectively. A description of these three series of shipboard tests conducted with the AN/WQM-5 is included in Appendix A. In summary, the testing and use of this unit aboard ship proved highly satisfactory.

On 22 February 1971, the prototype AN/WQM-5 was demonstrated in the NAVSHIPS Sonar Systems Office. Some 50 persons attended this demonstration and witnessed the operation of the unit. After this demonstration, the prototype AN/WQM-5 was transported by station wagon to Norfolk, Virginia, for a demonstration to the STEP Working Group.

The first item of technical documentation required to be delivered with the prototype AN/WQM-5 was received on 22 January 1971. This was the operator's manual (erroneously titled "Operating Manual"). This item fell far short of what was required under ARL's subcontract and was officially rejected by ARL letter Serial E-17 of 16 February 1971. On 17 February at a meeting at NAVSHIPS, ARL received all remaining items of documentation, except the technical manual on the power amplifier subsystem. As of 31 March 1971, neither the power amplifier subsystem manual nor the revised operator's manual had been received by ARL.

C. Remeasurement of Element Impedance of the AN/SQS-23 TR-208A Transducer Aboard the USS VOGELGESANG (DD 862)

After 16 months service aboard the USS VOGELGESANG (DD 862), single element impedance measurements at operating power level on the TR-208A transducer (Serial BTD-2-69) were measured by Messrs. J. L. Shorey and J. J. Truchard on 18-19 January 1971. This transducer has previously been subjected to baseline measurements aboard ARL's

STEP barge, to shipboard measurements just after installation at the Boston Naval Shipyard, and to remeasurement aboard ship after six months service. In summary, the measurements after 16 months service proved the transducer in excellent condition. One element is open, but this condition has prevailed since installation; two other elements have now drifted slightly outside the acceptable range for impedance magnitude.

An interesting result of the January 1971 measurements was the verification of the -8 deg phase shift measured 10 months earlier. At that time, it was suspected that this phase shift was due to transducer aging, but measurement error was considered a remote possibility. The recent measurements refute the measurement error possibility, although they appear not to substantiate the aging theory. However, since transducer aging generally follows a logarithmic pattern, it might be quite reasonable for aging during the past 10 months to cause a phase shift small enough to be lost in the basic phase measuring accuracy of the equipment (± 2 deg). Complete results of these measurements will be incorporated into a technical memorandum as soon as data reduction is complete.

D. Procurement of Additional AN/WQM-5 Sonar Test Sets

Pursuant to the requirement of Contract N00024-70-C-1117, ARL initiated procurement action to obtain and to deliver to the Navy 21 additional AN/WQM-5 Sonar Test Sets. Based upon the rapidly acquired experience aboard ship with the prototype AN/WQM-5, ARL made many small changes to the original specification. These consisted mainly of human engineering oriented items concerning knobs, switch positions, cable length, etc. After incorporation of these changes into the specifications, a formal request for bid was issued by ARL in February 1971 and bids were opened in March 1971. By 31 March 1971, no contract had been awarded.

In mid-January 1971, ARL issued a purchase order to procure a second prototype power amplifier for the AN/WQM-5. The manufacturer of the original prototype amplifier expressed to ARL his belief that the entire package could be made more reliable and less unwieldy. Of particular importance was the fact that the lead-acid energy storage units could be replaced with capacitor units, with a considerable savings in weight and volume. It was ARL's intent that the procurement of this second prototype would permit the manufacturer of the power amplifier (Instruments, Inc.) to progress rapidly enough to incorporate this new design into the 21 new AN/WQM-5 sets. By 31 March 1971, the progress of Instruments, Inc., with this second prototype was believed satisfactory. The subcontract requires that a working breadboard of this new amplifier be demonstrated to ARL personnel during April 1971.

E. AN/FQM-10(V) Support and Configuration Control

1. Liaison with Scientific-Atlanta, Incorporated

It has been widely known for some time by all persons concerned with the AN/FQM-10(V) that the responsiveness of Scientific-Atlanta (S-A) with regard to support and documentation problems has been poor. To augment an already bad situation, it was learned in January 1971, that S-A's entire Ocean Sciences Group was being dissolved and absorbed by other groups. ARL letter Serial E-12 of 8 February 1971 delineated the many items of documentation lacking and the many instances of poor response from the company. S-A's letter of 4 March 1971 assured ARL (and NAVSHIPS) that this bad situation would be rectified. On 19 March 1971, Messrs. H. C. Evans of NAVSHIPS 00V35 and D. D. Baker of ARL visited the plant of S-A to discuss the many problem areas and to seek assurance that they would be remedied promptly. A result of this meeting is to be a definitive letter from S-A to Mr. Evans clearly

stating the schedule to be adhered to in remedying these problems and stating price and delivery information regarding the long awaited improvements to the AN/FQM-10(V), which were recommended by ARL more than one year ago.

2. AN/FQM-10(V) Improvement Program

In January 1971, personnel from NUSC/NL visited all of the TRF's and installed the S-A Sampling Digital Voltmeter (SDVM), Model 1166. The units were installed in accordance with ARL's recommendations previously tried and proved good aboard the STEP barge. The remaining problems with the SDVM installation concern (a) the fact that no documentation whatsoever was delivered with the units and (b) that one lot of defective reed relays has brought about a maintenance problem. S-A has been made aware of the vital need for the documentation, and they intend to have such a technical manual published within about two months. S-A has already taken steps to obtain other relays and provide them to the TRF's in appropriate quantities.

Two of ARL's previously recommended improvements to the AN/FQM-10(V) have been brought to light again at the meeting of 19 March 1971. These are the installation of improved protective circuitry for the scanner and the implementation of Pulse Vector Immittance Meter (PVIM) as both a general purpose pulse phasemeter and a voltmeter. Of particular importance in this connection is the capability to use the PVIM to measure transducer driving voltage and/or current. This modification was accomplished on ARL's PVIM after S-A forwarded parts and instructions in December 1970; however, it was never followed up with similar installations at the TRF's. As previously stated, S-A is scheduled to provide price and delivery information to NAVSHIPS in the very near future.

3. AN/FQM-10(V) Documentation

Several items of documentation, in addition to the technical manual for the SDVM, are still missing or require further work. All of these items will be discussed together. Their status, as of the meeting at S-A on 19 March 1971, will be presented.

S-A has essentially completed their editing and revision of the AN/FQM-10(V) Operator's Manuals. Rough draft copies have been made available to ARL for review. Further work on these documents has been suspended, pending the decision on whether AN/FQM-10(V) improvements will be made in the near future. If so, S-A will further revise the Operator's Manuals. If not, the new Operator's Manual will be typed and printed as soon as ARL completes the review.

The AN/FQM-10(V) Supplemental Maintenance and Calibration Manual, which is being purchased by ARL, was scheduled to be delivered to ARL in late December 1970. As of the meeting of 19 March 1971, final printed copies are to be completed by 30 June 1971. The manual exists at present in draft form, but has not yet been reviewed by ARL.

At the time of the meeting of 19 March 1971, S-A still had never come to ARL to install the AN/FQM-10(V) nomenclature tags and to inventory and verify ARL's documentation. This work had been accomplished some time ago at all of the TRF's but had never been done at ARL (the activity that is supposed to be the authority on the documentation). On 22-24 March 1971, Mr. Joe Pape, of S-A, did visit ARL and accomplish these two tasks. At last, ARL has an officially tagged and designated AN/FQM-10(V).

As previously mentioned, the total lack of documentation delivered with the SDVM's was a great disappointment and this was pointed

out in no uncertain terms to S-A. These manuals are scheduled for delivery during May 1971.

4. Rotation of Dummy Loads for Use with the AN/FQM-10(V)

In April 1970, ARL distributed the ARL Type 2 Dummy Load in quantities so that one was available for use with each of the AN/FQM-10(V) systems that contain the PVIM. Each load was equipped with a label that stated that it was calibrated on 1 April 1970, for a one-year period. ARL's intent was to rotate these units on a one-year basis.

In October 1970, one dummy load was forwarded to the Boston TRF and one to Mare Island, to prevent all five units from "expiring" simultaneously. These were distributed by ARL letter E-95 of 12 October 1970. In March 1971, replacements for the other three original dummy loads were shipped to Pearl, Mare, and Boston (ARL letter Serial E-26 of 29 March 1971). Of those units that have now been returned to ARL after use, none has shown a failure. Only slight changes in calibration values have been noted.

F. Refurbishment of 15-Ton Hoist for Mare Island TRF

By 31 December 1970, essentially all work on the refurbishment of the 15-ton hoist for the new test barge at the Mare Island TRF had been accomplished, with the exception of testing. ARL's plan was to use the hoist for transducer handling at Lake Travis to test this hoist to 15 tons dynamic load and 30 tons static load. This testing was accomplished on 25 January 1971; the dynamic test was 15 tons, the static test was 21.5 tons. Failure of a dynamometer prevented the 30 ton static test. These test results and a general description of the work accomplished on this hoist were incorporated in a technical memorandum entitled "Refurbishment of 15-Ton Hoist for Mare Island Transducer Repair Facility," (ARL-TM-71-3).

A short manual composed of part of the original parts manual and of drawings to show ARL's modifications was assembled and copies mailed to the Mare Island TRF at the time the hoist was shipped, on 27 January 1971.

G. Preparation of Sonar Dome Handbook for Surface Ships, NAVSHIPS 0967-412-3010

ARL was requested by NAVSHIPS 00V31 and 00V35 to assist in writing the "Sonar Dome Handbook for Surface Ships". The technical information was made available to ARL late in December 1970 in the form of a draft prepared by NAVSECNORDIV, accompanied by numerous comments from NAVSHIPS personnel. Mr. F. L. Crump of ARL took the information provided, re-organized it, and prepared a draft of the handbook. Copies of this draft were made available to NAVSHIPS in mid-January 1971, and Messrs. F. L. Crump and D. D. Baker of ARL met with Messrs. F. V. Graves and J. Rigdon of NAVSHIPS and D. West of NAVSECNORDIV on 28 January 1971. The draft was very thoroughly discussed and revised at this meeting. After these changes were incorporated into the draft, it was again circulated to NAVSHIPS and NAVSECNORDIV for a final review. Subsequent to this review, editing and preparing the report were completed at ARL. By 31 March 1971, the last of 325 copies of this handbook had been assembled and distributed.

V. AUTEC SONAR RANGE (ASR) DESIGN MONITOR EFFORT

A. Participation in Meetings Concerning AUTEC Sonar Range

ARL personnel participated in one Navy/Contractor Conference (N/CC) during this report period. Messrs. D. A. Smith and R. L. Rolleigh traveled to San Diego, California, to attend the N/CC on 17 February. Since NAVSHIPS personnel were present at this meeting, it will not be described in this report.

B. Review of GD/E Reports

ARL received the AUTEC Sonar Range Final Report on 5 January 1971. This document was reviewed and technical comments were prepared (ARL letter Serial E-15 of 15 February 1971) and hand carried to Mr. Russell Baline of NUSC/NL on 17 February 1971, at the N/CC in San Diego. These comments are presented in Appendix B of this report.

C. Research in Areas of Special Interest

In an effort to save installation costs of the AUTEC Sonar Range underwater array (namely, the shore cable), various proposals have been entertained concerning the number of coaxial cables required to service some number of array modules. The proposals involve the use of at least one coaxial cable per module hydrophone and as many as three projector cables, switched to individual modules with underwater switching gear. One obviously efficient solution would be to require only one coaxial cable per module. This single cable would have to service the hydrophone and both the high and low band projectors, in addition to supplying dc power and various control functions.

The present major problem associated with such a scheme is that the bandwidth required by the ternary code, which is used to transmit hydrophone information to shore, is too large to permit the frequency multiplexing necessary if only one cable is used. If this ternary code bandwidth could be reduced, the possibility of using one cable per acoustic module would be increased greatly. Toward this end, ARL has started with a very modest effort to experiment with a more sophisticated ternary decoder in an effort to trade off increased shorebased equipment complexity for reduced required bandwidth on the cable.

Progress to date consists of the construction of a ternary code generator comprised of two 36-bit shift registers whose outputs can be combined to produce an arbitrary 3 level code. The generator can be connected to generate a pseudorandom ternary sequence. Plans are being made to construct a breadboard of a convolution decoder during the next quarter.

APPENDIX A

THE UNIVERSITY OF TEXAS AT AUSTIN
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11 Feb 1971
DDB:sr
Ser E-13

From: Head, Electroacoustics Division

To: Commander
Naval Ship Systems Command
Department of the Navy
Washington, D. C. 20360
Attn: SHIPS 00V3

Subj: Prototype AN/WQM-5 Sonar Test Set; Acceptance Testing of

Introduction

After preliminary factory acceptance tests in December 1970, ARL received the prototype AN/WQM-5 on 4 January 1971 and began laboratory acceptance tests. However, before these tests could be completed, three opportunities have arisen in which the AN/WQM-5 has been used aboard ship to test installed transducers. The main purpose of this letter is to describe the unequivocal success with the use of this prototype system aboard ship.

Shipboard Tests

On 18-19 January 1971, the set was used to conduct single element impedance measurements at operating power level on the AN/SQS-23 TR-208A tranducer aboard the USS VOGELGESANG (DD 862). In this application, the set was used to conduct such measurements for the third time aboard this ship since installation of this particular transducer (serial BTD-2-69); this is part of a continuing program to monitor the condition of this transducer about each 6 months of service. The AN/WQM-5 was installed aboard this ship and used without incident to obtain a set of data virtually identical to the last measurements in this series, made in March 1970. No failed elements were discovered.

On 29 January 1971, ARL used the AN/WQM-5 to conduct impedance measurements on the 576 TR-203 transducers of the AN/SQS-26BX array installed aboard USS TRUXTON (DLGN 35). These measurements were conducted on an emergency basis

in answer to a request from NAVSHIPS PMS-387, because other measurements had prompted speculation that some 400 elements would have to be replaced. The ship was scheduled for deployment on 2 February 1971. The set was installed and used aboard TRUXTON with no difficulty in obtaining the required measurements. These measurements clearly indicated no need to replace 400 elements. Subsequent replacement of only about 90 elements, plus some additional inboard work on the sonar system, resulted in the ship meeting all sonar performance requirements and being able to sail on schedule. Thus, the AN/WQM-5 has already been used to fulfill one of its primary design goals -- to establish the true condition of the transducer array (the traditional whipping boy whenever sonar performance is degraded) and possibly shift the blame elsewhere. It is thus likely that the use of the AN/WQM-5 prototype has saved the cost of 310 TR-203 transducers, as well as avoiding the ensuing delay in ship's schedule.

On 3 February 1971, tests were conducted on another array of TR-203 transducers installed aboard the USS SAMPLE (DE 1048). Due to the experience aboard TRUXTON, the setting up and use of the AN/WQM-5 aboard SAMPLE was done very quickly and easily. These tests were in connection with a routine pre-arrival inspection on this AN/SQS-26BX sonar. The impedance measurements conducted with the AN/WQM-5 proved the transducer array to be in quite good condition, with only 16 elements that required replacement.

Time and Manpower Requirements

The test time required aboard VOGELGESANG was about 4 hours for 2 ARL engineers. Aboard the two AN/SQS-26BX ships, test time was 5 hours aboard TRUXTON and 70 minutes aboard SAMPLE. In both cases 2 ARL engineers and 2 helpers were used. If the emergency situation had not prevailed aboard TRUXTON, it is estimated that 3 hours would have been required (too many people were present; there was confusion over how, and even whether, to use the AN/WQM-5; tests were conducted from about 0000 hrs to 0500 hrs, etc.). It should be noted that 4 persons are not required. In these cases, plenty of help was available and was put to good use. The two ARL engineers alone could have made the measurements, but test time would have been roughly doubled.

It should be emphasized that the test times are based upon the use of ARL's digital printer to log the data. This item is not presently part of the AN/WQM-5. It is estimated that test times would generally be double the values reported without the printer.

In all three cases, only test times are given; an additional 3-4 hours is required for loading, set-up, take-down, and offloading of the AN/WQM-5. Some additional help is also required for these tasks, either from the ship's force or from shipyard technicians or mechanics.

It is understood that previous low-level VALP (Vector Admittance Locus Plots) measurements on AN/SQS-26 sonar required 2 men for 4 days. Thus, the high-level pulsed impedance measurements possible with the AN/WQM-5 not only are more meaningful as shipboard transducer tests, but also represent a considerable saving in mandays -- 3 or 4 versus 8.

Future Plans

Laboratory acceptance tests at ARL on the AN/WQM-5 prototype will be completed by 15 February 1971. Final field acceptance tests are scheduled for April or May 1971 aboard USS PARGO (SSN 650) on the AN/BQS-6B sonar, in cooperation with NAVSECNORDIV during pre-overhaul transducer array tests.

D. D. Baker

Distribution List:

1 cy: NAVSHIPS PMS-385
NAVSHIPS PMS-386
NAVSHIPS PMS-387
NAVSHIPS PMS-388

APPENDIX B

COMMENTS ON AUTEC SONAR RANGE
FINAL DESIGN REPORT
Part III
AUSR Shore Based Subsystem
Vol 4
Section 5

The following is a list of comments prepared by ARL concerning Part III, Section 5 of the ASR Final Design Report.

Sect 5	<u>Transducer Electronics and Communications Group</u>
Pg 1	Major inputs to the block diagram in paragraph 3 should also include power inputs, with a brief description of what powers and voltages are supplied.
Pg 2 Par 2	The last sentence indicates that there are six bottom units. Should there not be 10 receivers if 2 spares are provided?
Pg 2 Par 4	The bottom hydrophone selector switch corresponds to the BMU selector switch shown on Fig. 1. This correspondence is not easily seen, although inserting "(BMU)" after "The bottom hydrophone" in the first sentence would clarify the relationship.
Pg 3/4 Fig. 1	The number of signals going to the bandpass filters after the BMU selector switch is not shown.
Pg 3/4 Fig. 1	Drawings or specifications for the Relay, Power Isolation filters, Isolation filter and D/A converters should be provided (or referenced if the information is already provided in the text).
Pg 6 Fig. 2	The 1 of 8 BMU Select Switch and BMA or VA Select Decoder labels are barely legible. The number of signals from the BMA or VA Select decoder is illegible.
Pg 7/8 Fig. 2	The Time Tag Decoder that appeared in the first Interim Report (Sheet 2) is missing from the newer schematic. Is it no longer required?

Pg 7/8	Detailed circuit diagrams for the control logic in the Acoustic Acquisition System are not shown.
Pg 9/10 Fig. 3	The yes output of diamond 17 should bypass diamond 4 as both VA and BMA logic must be reset.
Pg 9/10 Fig. 3	In the text, box 24 "Receive Message" is described as recording the message. How can this be done before it is decided whether the message is Tracking or a 36-bit word? In Fig. 1 the VA signals go to the data assembler before they go to the recorder, yet in Fig. 3 recording (box 24) occurs before the signals go to the data assembler (box 28). Where does the 36-bit word referred to in the fourth paragraph on page 11 originate? Does it come from the VA or from the computer to determine VA gain settings? According to Fig. 1, the VA is never used in the ADL.
Pg 9/10 Fig. 3	Diamond 3 indicates that a system check is made. This is clarified in the text to be a dc power level check. It would be more explicit to replace "System" with "dc Voltage" in diamond 3 to provide an indication of the function being performed.
Pg 9/10 Fig. 3	The BMA Diamond should have a 4 beside it. The flow chart does not show any interconnection between the computer and the acoustic acquisition system.
Pg 16	How many message generators are provided--one for each VA hydrophone?
Pg 17 Fig. 4A	On page 13 the output of this circuit is given as 1 V to 10 V rms. Since the input diode will clip the input signal and since there is no voltage gain in the circuit, it cannot produce 1 V output. The input signal should be described more fully.
Pg 18 Fig. 5	The external compensation for the MA 709 op amp should be shown.
Pg 19 2)	What output noise level is now specified?

Pg 20 Fig. 7	The + and - inputs of the 709 op amp should be indicated.
Pg 20 Fig. 7	Are dc offset voltages of concern? If so, offset adjustments should be shown.
Pg 21 2) b)	The output level of "+5 V + 0, -3" probably means "+5 V + 0, -3 = logical 1," in which case the specification for logical 0 should also be shown.
Pg 22 Design Approach Par 3	In line 4, it is believed that a typographical error has occurred and that the sentence should be completed "while the $\overline{Q}$ output of the -channel flip-flops serves as the other."
Pg 22 Last Par	Would it not be more correct to say that "For a bad word output, *any one of* the following three conditions is needed: 1) not zero averaged 2) not a good word 3) not in sync." Is a bad word output defined as a logical 1 or a logical 0?
Pg 25/26 Fig. 9	Characteristics of the two transformers on this figure are not specified. The label at D5 is not legible.
Pg 25/26 Fig. 9	The bias voltages shown as "(+)V(5)" and "(-)V(5)" are presumed to be +5 V and -5 V. The way they are written is somewhat confusing.
Pg 27/28 29/30 Fig. 10 Sheets 1 and 2	It would be helpful if the approximate phase delay for ØC were shown on the drawing. It would be helpful if the zero average, Word sync out, FW out, Good Word, and Bad Word outputs were labeled to show what logical state occurs when the outputs are valid. If a 1 indicates a true state for all the outputs, a single comment that the "Inputs and outputs are logical 1 when true" should be sufficient.

Pg 31 Par 2	The ternary encoding/decoding table should be shown or referenced here. It would be helpful it it were indicated that the first ternary bit to arrive is the right hand bit of the ternary code.
Pg 33/34 Fig. 11	In area 1A of the drawing, lines labeled "load pulse" and "shift clock" are shown that originate in Processor 6403003. The corresponding signals do not appear on the drawing for Processor 6403003.
Pg 37/38 Fig. 12A	The source of the input lines at D5 should be indicated. The J-K inputs of the SN 54H102 should be labeled.
Pg 37/38 Fig. 12A	Resistance and capacitance values and the type of op amp for the output amplifier are omitted from the drawing.
Pg 39 Par 1	The diagram of Fig. 13 might more appropriately be called a circuit diagram rather than a logic diagram.
Pg 37/38 Fig. 12A	It is not apparent from the drawing that two SN 5496 shift registers are required. The input to the preset is shown on the drawing as an AND gate. It should be shown as a NAND gate. Why not use SN 7496 here? Why not use 74H102 instead of 54H102?
Pg 40	Drawing 6404004 for the Acoustic Data Link Receiver (FSK Demodulator) would normally follow the drawing for the bandpass filters, 6404003. The drawing is missing, however, and the FSK Demodulator is not discussed in the text. Detailed circuit diagrams of the FSK Demodulator are not provided.
Pg 35/36 Fig. 12	The serial to parallel converter is not shown in Fig. 12.
Pg 37 and 41 Figs. 12A and 14	Are the 36 bidirectional lines shown in these two drawings the same?
Pg 39 Par 5.1 - 4.4	This paragraph refers to a clock in the underwater package, but there is no clock in the underwater package.

Pg 37/38
Fig. 12A

Why does output of preset 1 command analog receiver 1 but the output of preset 3 control analog receiver 8?

Pg 41/42
Fig. 14

The holding register outputs are continuously present on the 36 bidirectional data lines. If a holding register output is a zero, as occurs for all registers when the message detect circuit sends a clear signal or when the input data so dictate, the bidirectional data lines cannot be used for sending and receiving other messages. This does not appear to be an acceptable interface arrangement.

Pg 41/42
Fig. 14

The AND gate at the preset input of the SN 5496 is more correctly shown as a NAND gate. Why not use 74 series components here?

Pg 41/42
Fig. 14

The source of the lines at D5 should be shown on the drawing. The total number of shift registers, holding registers, and control gates should be indicated on the drawing.

Pg 43/44
Fig. 15

The title and some of the writing on this diagram is not legible. The interface boxes that precede and follow the AN/UQC do not have circuit diagrams and circuit diagram numbers shown.

Pg 45/46
Fig. 16

There are no drawings or drawing numbers for the

1) Phase Coded Signal Processor
2) Time Tagging Circuit
3) Output Register
4) Steering Gates and Interface Hardware (this is found elsewhere but should be referenced here).

Pg 47

It is not clear what is meant by a binary, phase coded signal.

Pg 47
5.1.6

The phase coded signal generator may be described elsewhere but the discussion and drawing are not easily found if available.

Pg 47
5.1.6.3

The description of the output pulse omits any indication of what time relationship exists between the pulse and some unspecified timing reference. Does the leading or trailing edge of the pulse carry the timing information?

Pg 48 Par 5.1.7	The term "Time of Arrival Processor" is somewhat confusing. Referring to Fig. 1, a Time of Arrival Detector is shown but no time of arrival processor; Fig. 16 indicates that the two terms are interchangeable, but it would be better to use one or the other consistently.
Pg 48 Par 5.1.7	Previous discussions of the Time of Arrival Detector indicate that a binary phase coded signal is supplied to the input of the Time of Arrival Detector (Par 5.1.6.1 and Fig. 16). Paragraph 5.1.7 indicates that the Time of Arrival Processor requires a straight analog signal. The two discussions are inconsistent.
Pg 48 Par 5.1.7.1	The specifications of the D/ac should refer to section 5.2.3.1 2), page 97, where they are given more completely.
Pg 49/50	It appears that some provisions are required that will prevent changing the selection of the 8 of 16 digital channels in the middle of the transmission of the serial data from the digital receiver to the TOAD. This inhibiting process should be discussed.
Pg 49/50 Par 3	The second sentence mentions "the FF's" although no previous mention of the SN 5496 flip-flops has been made. The third sentence indicates that "the flip-flop supplies one input for each of their AND gates." "The flip-flop" and "their" are somewhat hard to relate to the items under discussion.
Pg 49/50 5.1.9 Par 2	The discussion indicates that the Q output of the FF serves as a positive input for each of 2 AND circuits. The drawing shows the $\overline{Q}$ output as supplying the signal to the AND circuits. It is believed that the drawing is in error.
Pg 49/50 5.1.9 Par 3	"The emitters are capacitively coupled in pairs" can be misread to mean that the emitters are tied together by capacitors. The drawing indicates that the emitters are directly connected in pairs and capacitively coupled to the Time of Arrival Detector.

Pg 51/52 Fig. 17A	SN 54 series components are used in this circuit. Why not SN 74 series?
Pg 53/54 Fig. 17B	What is the source of signal lines at D5? J-K inputs of SN 54H102 should be labeled.
Pg 61/62 Fig. 18	The writing in the box labeled "A > 2^{MBIT}" (?) is not legible on the drawing.
Pg 69/70 Fig. 18C Pg 67/68 Fig. 18B	The overload condition of $2^{11}-1$ implies that an 11-bit sample of all ones has occurred. Should the overload condition be $2^{12}-1$?
Pg 63/64 Fig. 18A Pg 61/62 Fig. 18	No circuitry is shown for taking the absolute value of the signal indicated in Fig. 18A.
Pg 73/74 Fig. 18E	Drawing numbers (or circuit diagrams) for the VA Signal Conditioner Gain Control Preprocessor are not provided.
Pg 75	In line 2, what is meant by "(50 MS pulse --)"?
Pg 75	No circuit diagram numbers for the Gain Data Device Controller are indicated in the discussion or shown on the drawings.
Pg 77/78 Par 1 B	In the sentence, "It can be seen that this unit takes ...", the object referred to by "this unit" is not clear.
Pg 77/78 Par 2 B	Should the comma between ADL and encoder in the second line be used, or does the sentence intend to refer to the ADL encoder? If the encoder is a separate device, what specific encoder is referenced?
Pg 77/78 Par 3 B	From Fig. 19, it appears that the one address required to select ADL or tracking signals is the Signal Source Selector address and that the two addresses required for sonar signal transmission are the Signal Selection and Equilization address and the VA Projector Selection address. If these assumptions are correct,

it would be helpful to place the names of the devices to be addressed in parentheses at appropriate places in the discussion, i.e., "... to transmit ADL or tracking signals to the bottom arrays (Signal Source Selector address); but it ...". It would also be desirable to call the Signal Source Selector the BA Signal Source Selector and to call the Signal Selection and Equilization the VA Signal Selection and Equilization in order to reduce the possibility of confusing the functions of the two switching networks.

Pg 79/80 Fig. 19 — The AN/WQC-2 designation has been changed in the discussion and on earlier drawings to AN/UQC (e.g., Fig. 15). Would it be appropriate to change the designation on this drawing?

Pg 79-80 Fig. 19 — The right hand edge of the copy supplied for review is illegible; this appears to be a reproduction problem.

Pg 81/82 Fig. 20 — The box labeled "< 20 ms delay notify E.D.V." has no number. The 150 msec delay described on pg 83, par 9, is not shown on the flow chart.

Pg 83 Par 6 — The subject referenced in the sentence "It accepts signals from ..." is not clear. ("It" probably refers to the control logic, but the preceding discussion speaks of the Control Logic Diagram.)

Pg 85/86 Fig. 21 — Circuit diagrams for the Control Logic are not provided. Is it intended that the AND-OR logic of Fig. 21 be implemented with NAND-NOR circuit elements? What do the registers, address decoders, and delay elements look like circuitry-wise?

Pg 85/86 Fig. 21 — What inhibits FF-1 and FF-2 from changing to the transmitting state if a start pulse occurs but the address decoder has not been sent the necessary address code? This condition appears to arise for FF-1 when the BA transmitters are addressed and

to arise for FF-2 when the VA transmitters are addressed. The discussion implies that the output of the delay is 1 except for 20 msec after an address is delayed. The 150 msec delay circuit, discussed on pg 83, is not shown. Control Logic is not a very specific title because of the large number of control functions performed elsewhere.

Pg 89/90 Fig. 22 — Should WQC-2 be changed to UQC?

Pg 89/90 Fig. 22 — Circuitry to implement most of the functions shown on this diagram are omitted. From the discussion, the switches at the output of the circuit are apparently relays and the drawing does not indicate this fact.

Pg 91/92 Fig. 22A — Component values and semiconductor types are omitted from this drawing.

Pg 93 Par 2 — "Register IV" on Fig. 21 probably refers to Register I. Decoders are not numbered on Fig. 21 so the reference to "decoder 1 in Fig. 21" cannot be verified.

Pg 94 Par 1 — Design of the equalizers is not included but will commence after tests (according to a comment in this report).

Pg 94 General 1 — The comment that "no direct chassis ground is allowed" is believed to mean that circuit ground will not be tied to chassis ground. The statement can be interpreted to mean that the chassis cannot be grounded.

Pg 94 5.2.2 — What is meant by a *phase-coded* signal, as used in the first paragraph and in *Output* 1? No diagrams are provided for the Phase Coded Signal Generator.

Pg 95 — No circuit diagrams for the signal converter are provided. Which computer sends the data to the time-shared processor that subsequently is used by the D/A converter for generating the basic

analog sonar signal? If it is the CSP-30, is the output rate limited to the same 1K word/sec that is mentioned as the input rate on pg 75?

Pg 95 — The important parameters mentioned in the last paragraph are given values in 5.2.3.1, 7). It would be helpful if the location of this information were referenced on pg 95.

Pg 98
5) — What are the terminating impedances for the attenuator?

Pg 99
5.2.3.2
Par 3 — The text and Fig. 25A indicate that a binary code will be used to provide the required attenuation value. The code for 119 is listed on pg 96 as 100011001, which is a BCD code. If the code table is correct, then the pads in Fig. 25A have incorrect attenuation values.

Pg 101
Fig. 24
Pg 102
Fig. 25 — Tables showing component values versus cutoff frequency should be included on these drawings.

Pg 100
Fig. 23 — The output amplifier is shown as a 709 or 148; a more complete designation should be provided.

Pg 103 — What does LPF stand for on the drawing? It probably stands for lowpass filter, but the abbreviation does not appear in the Glossary of Terms in this form. If the Glossary of Terms listing were changed to LP(F) instead of LP, the abbreviation should be acceptable. The ground line should be labeled.

Pg 104
5.2.4.1 — The reader is referred to AN/UQC-2, transmitter portion. Where is this reference available — UQC Operation Manual, UQC maintenance manual, another volume in this report? The characteristics should be provided here if they are not available in another section of this report.

Pg 104 5.2.5	The specifications which the projector amplifiers must meet should be specified here. Manufacturers and model numbers have not been specified.
Pg 105 Address No. 2 Table	Either the No. 31 (decimal) under Code for Projectors should be changed to No. 37 (octal), or the No. 40 (octal) should be changed to No. 32 (decimal). (The code in the table for Address 3 is decimal so that consistency between tables would call for changing the No. 40 to No. 32.)
Pg 105 Last Par	Switch model numbers and manufacturers have not been specified.
Pg 106 5.3.1	It would be helpful if the "DATA-CONVERTER" in the paragraph heading were changed to the "RDL DATA CONVERTER" to differentiate this converter from other data converters in the system. No circuit diagrams are provided for the RDL Data Converter.
Pg 107/108 Fig. 26	It would be desirable to label the boxes shown on Fig. 26 with titles that indicate that the items are exclusive to the radio data link, e.g., RDL Data Buffer, RF Transmitter, etc.
Pg 107/108 Fig. 26	No drawing numbers are provided for the items shown in this box diagram.
Pg 110 Fig. 27	It would be desirable to include P/S in the Glossary of Terms.
Pg 110 5.3.2	It would be helpful to relabel the "DATA CLOCK" the "RDL DATA CLOCK."
Pg 115 2) c)	Is the transmitted bit rate the same as the received bit rate (1200 bps)? Should the title of c) be expanded to include the transmit clock function?
Pg 115	Detailed circuit diagrams for the RDL Data Clock are not provided.
Pg 117 5.3.3	It would be helpful to relabel the "DATA BUFFER" the "RDL DATA BUFFER."

Pg 117	Detailed circuit diagrams for the RDL Data Buffer are not provided.
Pg 118 6)	According to the word formation, pg 109, the gap between transmissions is four bits long. According to 6) in the operating sequence discussion and to Fig. 31, the gap must be at least 5 counts wide before the data can be loaded into the parallel Storage Register.
Pg 118 7)	What is meant by "count 9 (variable)"?
Pg 118 10)	What is meant by "The cycle is not repeated (diamond 16, and 17)."?
Pg 121/122 Fig. 31	The short gap signal described in the flow chart and in the discussion does not appear on Fig. 31 or Fig. 26.
Pg 121/122 Fig. 31	What does the term "(strapped)" which appears at output 9 of the 10-state counter signify?
Pg 121/122 Fig. 31	Figure 31 shows the FSK signal connected to the Tone Detector. Figure 29 shows the FSK to Gap Detector signal. Are the Gap Detector and Tone Detector the same item?
Pg 123	Manufacturer's name and model number for the radio transmitter are not shown.
Pg 123	Manufacturer's name and model number for the radio receiver are not shown.
Pg 124	A drawing of the RF Antenna is not provided.

ADDENDUM TO COMMENTS
AUTEC SONAR RANGE
FINAL DESIGN REPORT
Part III
AUSR Shore Based Subsystem
Vol 4
Section 5

Pg 31
Par 2

It is not apparent how the bad words, frame words, and alternate frame words are prohibited from passing through the BCT to binary converter to the D/A Converter. This should be discussed.

Pg 29/30
Fig. 10
Sheet 2

Where are the FW Detectors referred to at (1D) shown? The drawing number should be referenced.

Pg 38/39
Fig. 12A

Because the clear input to the SN 54H102 sets $\overline{Q}$ to a logical 1, the control gates for the SN 5496 shift registers are in a state that requires only a 1 condition to be present on the bidirectional lines in order for the output function to be activated after a clear pulse. It would appear that the Q output of the SN 54H102 should be used to control the SN 5496's rather than the $\overline{Q}$.

With the circuit arrangement as shown, does it not require that the condition of the bidirectional lines controlling the SN 5496 input gates be established with the desired control code before the device is addressed or that all bidirectional lines be grounded at the time of addressing the device? One of these precautions appears necessary to prevent false response of the selector gates and some comment to this affect should be contained in the text. These problems also arise in Figs. 14, 17A, and 17B.

APPENDIX C

PROJECT DIVISIONS UNDER CONTRACT N00024-70-C-1117

a) STEP Barge Operations, Construction, and Maintenance
b) STEP Barge Transducer Tests
c) AN/FQM-10(V) Improvements and Configuration Control
d) AN/WQM-5 Prototype Testing, Use, and Demonstration
e) Sonar Dome Handbook
f) 15-Ton Hoist Renovation
g) Electronic Scanner Testing
h) AUTEC Sonar Range Monitoring
i) AN/BQH-2 Submarine Sonar
j) Part-time Student Assistance
k) General Technician Assistance

TECHNICAL PERSONNEL ASSIGNED TO CONTRACT N00024-70-C-1117

Name	Project	Approximate Fraction of Time Assigned	Title
D. D. Baker	a - i	0.85	Head, Electroacoustics Division
E. Blum	a,f	0.75	Section Supervisor
D. A. Smith	h	0.30	Section Supervisor
J. J. Truchard	b,c,d,g	0.75	Section Supervisor
K. W. Alkier	i	1.0	Technical Staff Assistant
G. C. Badke	k	0.30	Laboratory Research Assistant
T. A. Brun	j	0.55	Laboratory Research Assistant
W. M. Chaffee	j	0.50	Research Scientist Assistant
F. L. Crump	b,c,e	1.0	Research Scientist Associate
G. E. English	i	0.50	Research Scientist Associate
W. P. Lawson	k	0.40	Technical Staff Assistant
P. R. Mongrain	k	1.0	Technical Staff Assistant
R. L. Rolleigh	j	0.50	Research Scientist Assistant
J. L. Royal	a,b	1.0	Research Scientist Associate
V. D. Scott	h	0.25	Research Scientist Associate
B. S. Shaw	d,i,g	0.70	Research Engineer Associate
J. L. Shorey	b,c,d,g	1.0	Research Scientist Associate
R. D. Smith	j	0.60	Research Engineer Assistant
R. L. Sullivan	h	0.10	Research Scientist Associate

28 May 1971

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13. ABSTRACT

This report summarizes the accomplishments under Contract N00024-70-C-1117 (with the exception of the submarine sonar work), during the period 1 January through 31 March 1971. ARL has continued to assist and support NAVSHIPS by (1) completing extensive baseline measurements on the AN/SQS-23 TR-208A (Serial B-8) transducer; (2) completing receiving beam pattern measurements on the same transducer; (3) successful shipboard use of the AN/WQM-5 sonar test set to check transducer performance on one AN/SQS-23 and two AN/SQS-26 sonars; and (4) completion of the comparison testing of the ~~C-Tech, Ltd.~~, electronic scanner versus the AN/SQS-31 mechanical scanning switch, resulting in the ~~C-Tech unit's~~ first being judged acceptable. Stanford Research Institute, under Subcontract to ARL, has contributed heavily toward preparing to implement a pilot repair run on AN/SQS-26BX TR-203 transducer elements at the Mare Island TRF. ARL personnel have continued to assist the Naval Underwater Systems Center/~~New London Laboratory~~ with monitoring the development of the AUTEC Sonar Range. (U-FOUO)

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STEP Barge Facility						
High Level Impedance Measurements						
Transducer Repair Facilities						
Transducer Testing at Naval Shipyards						
AUTEC Sonar Range						
Sonar Calibration						

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